

DOCTOR OF PHILOSOPHY

CONVECTIVE BOUNDARY LAYER PARAMETERIZATIONS IN HIGH-RESOLUTION MESOSCALE MODELS

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In this dissertation, the issue of grid resolution and the sub-grid scale (SGS) parameterizations in a mesoscale model are addressed. Particular concern relates to increasingly high-resolution mesoscale atmospheric numerical models, in that sub-grid scale parameterization of atmospheric processes becomes unclear when the grid resolution becomes comparable to the length scale of the phenomenon. Observational analysis is performed to better understand the scales of turbulence in various environmental conditions. The ability of the U.S. Navy's current Coupled Ocean-Atmosphere Mesoscale Prediction System (COAMPSTM) to perform accurately within the resolvable scales and to accurately represent the boundary layer turbulence mixing when the resolution is high is analyzed, using a case study of boundary layer roll vortices in cold air outbreak conditions over the Japan/East Sea. Based on results from the above analysis, the existing turbulence parameterization is modified towards more realistic representations of the turbulent processes over a relatively wide range of grid resolution. This modification within COAMPSTM results in a more realistic simulation of the BL structure compared to observations, with improved spatial variability in the mean fields, and better representation of the turbulent structure in the SGS parameterized fields.

KEYWORDS: Grid Resolution, Parameterizations, Boundary Layer, Mesoscale Modeling, COAMPS